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भारतीय मानक

18 प्रतिशत निकल मेरेजिंग इस्पात सरिया एवं छड़ें — विशिष्टि

Indian Standard

18 PERCENT NICKEL MARAGING STEEL BARS AND RODS — SPECIFICATION

ICS 77.140.60

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1999 **Price Group 2**

Specials Metals and Alloys Sectional Committee, MTD 27

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Specials Metals and Alloys Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Maraging steels are widely used in nuclear, aerospace, tool and die applications and with the increase in use and manufacture of these steels, it has become necessary to formulate a National Standard covering the requirements of maraging steels, particularly 1725 MPa grade in the form of bars and rods.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

18 PERCENT NICKEL MARAGING STEEL BARS AND RODS — SPECIFICATION

1 SCOPE

This specification covers the requirements of maraging steels with 18 percent nickel in the form of bars and rods of size less than 62.5 mm nominal diameter.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
1608 : 1995	Method of tensile testing of steel products (*second revision*)
3739 : 1987	Dimensional tolerances for carbon and alloy constructional steel products (*first revision*)
4163 : 1982	Method of determination of inclusion content in steel by macroscopic method (*first revision*)
4748 : 1988	Method for estimating average grain size of metals (*first revision*)
7739 (Part 5) : 1976	Code of practice or preparation of metallurgical specimens: Part 5 Steel and their examination
10180 : 1982	Method for plain strain fracture toughness testing of metals
13015 : 1991	Steel products macroetch testing, inspection and rating

3 MANUFACTURE

3.1 The steel shall be manufactured by vacuum induction melting followed by a consumable electrode vacuum arc remelting.

3.2 The word ingot shall mean cast of consumable electrode vacuum arc remelted steel.

3.3 Other manufacturing processes may also be considered if agreed to between the purchaser and the manufacturer.

4 CHEMICAL COMPOSITION

4.1 Chemical analysis shall be made by the supplier on each vacuum are remelt ingot at a convenient stage of processing. The chemical composition thus determined shall not vary from specified range as given in Table 1. Method of chemical analysis shall be mutually agreed between supplier and purchaser.

Table 1 Chemical Composition

(*Clause* 4.1)

Element	*Minimum*, Percent	*Maximum*, Percent
Carbon	—	0.03
Sulphur	—	0.01
Phosphorus	—	0.01
Manganese	—	0.10
Silicon	—	0.10
Chromium	—	0.50
Copper	—	0.50
Nickel	17.0	19.0
Cobalt	7.0	8.5
Molybdenum	4.6	5.2
Titanium	0.3	0.6
Aluminium	0.05	0.15
Iron	Balance	—

4.1.1 During vacuum induction melting, up to 0.05 percent calcium, 0.02 percent zirconium and 0.003 percent boron shall be added.

5 PRODUCT ANALYSIS

5.1 One sample per heat shall be taken for product analysis.

5.2 The permissible variation in the case of product analysis from the limits specified in Table 1 shall be as follows:

Element	*Permissible Variation*	
	Under the Minimum Percent	Over the Maximum Percent
Carbon	—	0.005
Sulphur	—	0.005
Phosphorus	—	0.005
Silicon	—	0.05
Manganese	—	0.03
Nickel	0.15	0.15
Cobalt	0.10	0.10
Molybdenum	0.10	0.10
Titanium	0.05	0.05
Aluminium	0.005	0.01

6 SUPPLY CONDITION

6.1 The bars/rods shall be supplied in solution annealed condition.

6.2 Straightness and dimensions tolerances shall be as per IS 3739.

6.3 Surfaces shall be free from cracks, seams, laps, shrinkages and other serious discontinuties visible to the naked eye.

6.4 Other quantitative inspection methods may be employed if agreed to between the supplier and the purchaser.

7 HEAT TREATMENT

7.1 Solution Annealing

Solution annealing shall be performed by heating to a temperature between 810 and 830°C held for a minimum 1 hour/25 mm of thickness, but not less than 1 hour and cooled in air or water to room temperature. A second solution treatment is permissible.

7.2 Maraging Treatment

Maraging treatment shall be performed on test specimens or on the finished components at 485 ± 5°C for 3 hour minimum followed by air cooling.

7.3 Any change in heat treatment cycle referred in **7.1** and **7.2** shall be mutual agreement.

8 MECHANICAL REQUIREMENTS

8.1 Sampling Plan

8.1.1 Test specimens shall be drawn from each solution annealing batch.

8.1.2 If particular size of the bars or rods constitute one solution annealing batch then testing shall be carried out on any one rod or bar from that batch.

8.1.3 If different sizes of bars or rods constitute one solution annealing batch then testing shall be done on each size of bar or rod from that batch.

8.2 Mechanical Test Requirements

8.2.1 The properties in aged condition, tested in longitudinal direction, shall conform to the values given below:

0.2 percent proof stress, MPa	1 725	*Min*
Tensile strength, MPa	1 785	*Min*
Elongation (G.L. = 4 d), percent	8	*Min*
Reduction in area, percent	40	*Min*
Hardness	48	HRC, *Min*

8.2.2 *Test Specimen Heat Treatment*

Ageing of test specimens shall be in accordance with **7.2.**

8.3 Number of Tests and Specimen Type

8.3.1 *Tensile Test*

8.3.1.1 Tensile test specimens in accordance with IS 1608 shall be used. Three specimens shall be tested.

9 RETESTS

9.1 If any test sample selected in accordance with **8** fails to comply with the mechanical requirements of this specification the supplier shall adopt either of the procedures as specified in **9.1.1** or **9.1.2**.

9.1.1 Samples may be cut from bars or rods 'as-is' condition in accordance with **8** and tested.

9.1.2 The product may be reheat treated and tested in accordance with **8**.

10 MECHANICAL ANALYSIS

10.1 Sampling Plan

One test sample shall be taken per size and per heat.

10.2 Microstructure of the solution annealed samples shall be completely martensitic. Banded structure up to 5 percent area is permitted. Specimen area shall be minimum 200 sq.mm. Samples for microstructure shall be prepared in accordance with IS 7739 (Part 5).

10.3 Grain size of solution annealed sample shall be number 5 or finer with occasional 4 subject to maximum of up to 15 percent of the field of view. Average grain size shall be determined in accordance with IS 4748.

10.4 Inclusion rating of solution annealed and aged samples when carried out in accordance with the method specified in IS 4163 shall not be inferior to that specified below:

Inclusion Type		*Rating*	
		Thin	Heavy
A	(Sulphide)	1.0	1.0
B	(Alumina)	1.0	1.0
C	(Silicate)	1.0	1.0
D	(Globular Oxide)	1.0	1.0
EB	(Titanium Nitriderated in the same way as type B inclusions)	1.5	1.5
ED	(Titanium Nitriderated in the same way as type D inclusions)	1.5	1.5

11 VISUAL INSPECTION AND NON-DESTRUCTIVE TESTING

All bars and rods shall be free from defects such as cracks, seams, laps, voids shrinkages and other discontinuities. Ultrasonic test procedures and acceptance criteria shall be agreed upon between the supplier and the purchaser.

12 SUPPLEMENTARY REQUIREMENTS

12.1 Either or both of the following two supplementary requirements (**12.1.1** and **12.1.2**) shall apply only when specified by the purchaser in the enquiry, contract and order. Details of these requirements shall be as agreed to between the purchaser and supplier.

12.1.1 *Macroetch Test*

When specified, product shall be subjected to macroetch test for freckles, white spots, radial segregation and ring pattern and after macroetching the thin section shall be maximum of severity B. However for ring pattern, severity of the order of C is acceptable as specified in IS 13015.

12.1.2 *Fracture Toughness*

When specified product shall be subjected to fracture toughness testing and the acceptable plain strain fracture toughness value should not be less than 80 MPa$\sqrt{M}$. Method of test and standards for acceptance shall be as agreed to between the supplier and the purchaser. Method as specified in IS 10180 is a suggested method of test for bars.

13 MARKING

13.1 The bars/rods shall be identified with heat number, grade and supply condition.

13.2 The material may also be marked with the Standard Mark.

14 PACKING

Each bar or rod shall be given protective coating to avoid rusting.

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Amendments Issued Since Publication

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 323 01 31, 323 33 75, 323 94 02

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	323 76 17 323 38 41
Eastern	: 1/14 C. I.T. Scheme VII M, V. I. P. Road, Kankurgachi CALCUTTA 700 054	337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160 022	60 38 43 60 20 25
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